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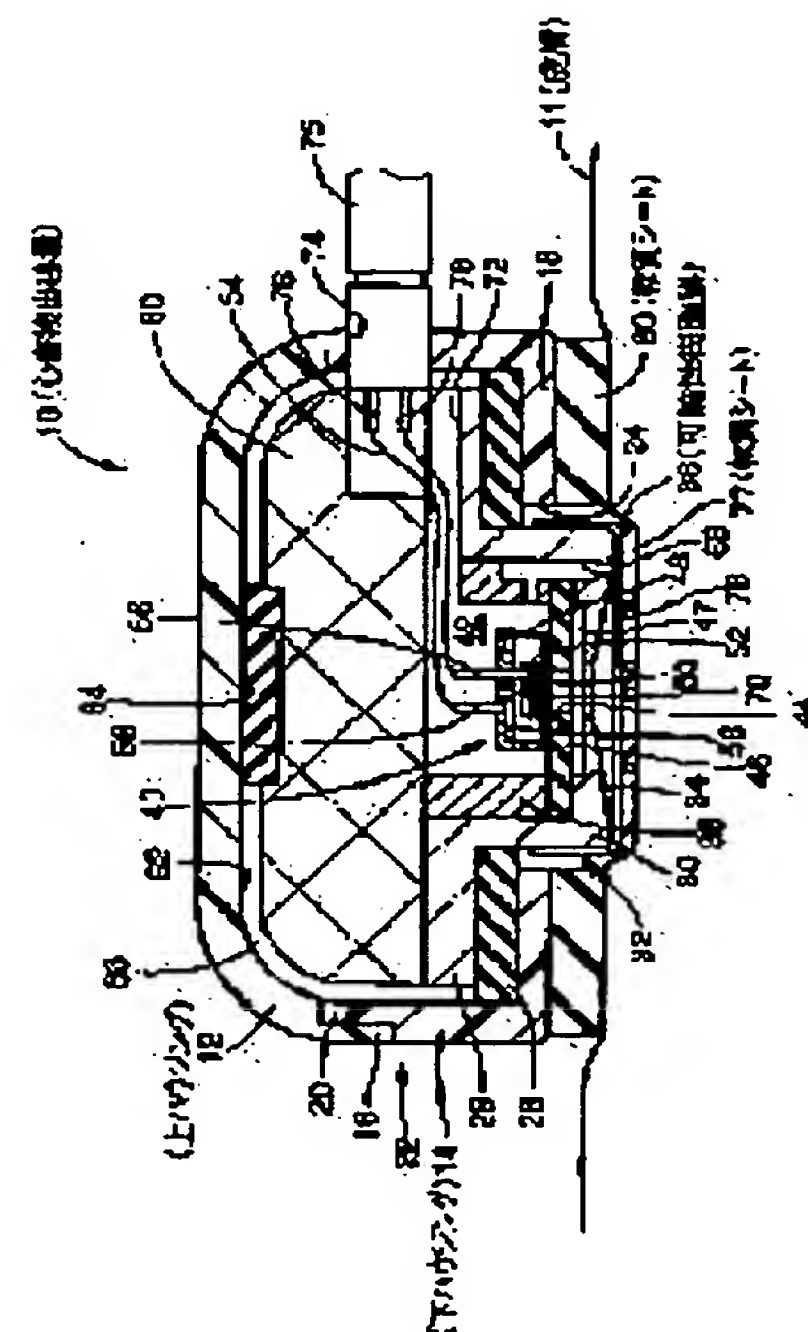
(22)Date of filing : 19.08.1998 (72)Inventor : SUZUKI HIDENORI

(54) SHEET FOR MOUNTING BIOLOGICAL SOUND DETECTOR

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a sheet for mounting a biological sound detector for reducing the feeling of incompatibility at the time of mounting the biological sound detector and suitably detecting biological sound by the biological sound detector.

SOLUTION: By interposing a soft sheet 76 provided with viscosity almost similar to the skin 11 between a flexible resin film 36 and the skin 11, the feeling of the incompatibility at the time of mounting a heart sound detector is reduced. Further, since body hair 78 on the surface of the skin 11 with which the flexible resin film 36 is in contact is covered with the soft sheet 76 without a clearance, that is since an air layer is not formed between the flexible resin film 36 and the skin 11, heart sound waves are not reflected on the boundary surface of the air layer. Since the intrinsic acoustic resistance R of this sheet for mounting is closer to the intrinsic acoustic resistance R of the skin 11 than the intrinsic acoustic resistance R of air, the reflection of heart sound on the boundary surface of the skin 11 and the soft sheet 76 is relatively little and thus, the reduction of the heart sound detected by the heart sound detector due to the hairiness of a living body is suitably prevented.



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CLAIMS

[Claim(s)]

[Claim 1] The living body sound detection equipment with which is equipped with the microphone which is formed in housing which has opening at the pars basilaris ossis occipitalis, and is stuck by this opening side on a living body's skin, the comparatively hard flexible film which plugs up this opening, and this housing, and changes vibration of a diaphragm into an electrical signal, and it is equipped on this living body's skin, The sheet for wearing of the living body sound detection equipment which is the sheet for wearing of the living body sound detection equipment made to intervene between this living body's skins, and is characterized by being made to intervene between said flexible film and said living body's skins, and having the same hardness as this living body's skin, and abbreviation.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] In order to diagnose diseases, such as a living body's heart and a respiratory system, this invention detects the living body sound made in the living body, and relates to a technique for a living body sound to be especially detected by the living body sound detection equipment in the much more suitable condition about the living body sound detection equipment which outputs the living body sound signal showing the living body sound.

[0002]

[Description of the Prior Art] For example, in order to diagnose the disease of living bodies, such as a heart disease and a respiratory system, it is equipped on the skin of a living body's predetermined part, and the diagnosis using the living body sound detection equipment which outputs the living body sound signal with which living body sounds, such as a heartbeat made in the living body, respiratory sound, a pleura sound, an artery sound, and an intestinal murmur, are detected, and the living body sound is expressed is performed. For example, the heartbeat detection equipment with which it is equipped on the skin of a thorax detects a heartbeat, a phonocardiogram is measured, and a diagnosis of a heart disease is performed from the phonocardiogram. Since the cardiac souffle which originates in a heart disease and is generated is contained in the phonocardiogram which measured the patient and was obtained in addition to a normal heartbeat when a patient has a heart disease, a heart disease can be diagnosed.

[0003] The above-mentioned living body sound detection equipment is what detects vibration of the skin by being transmitted to the skin, the acoustic wave, i.e., the living body acoustic wave, of a living body sound. Vibration of the skin is transmitted to the air in the living body sound detection equipment from opening by the side of the skin of living body sound detection equipment. Vibration of the skin is transmitted to one member of the air conduction type which detects a living body sound based on vibration of the air, and the living body sound detection equipment contacted on a living body's skin, and there is direct conduction type which detects a living body sound based on vibration of the one member.

[0004] In order to acquire the high living body sound signal of gain to the living

body sound detection equipment of the above-mentioned air conduction type, the living body sound detection equipment which plugged up with the comparatively hard flexible film opening of housing contacted on a living body's skin is proposed. For example, the heartbeat detection equipment given in Japanese Patent Application No. No. 120531 [nine to] for which these people applied previously is it. Since a sound room is formed [according to this heartbeat detection equipment] by plugging up opening in addition to there being an advantage that there are few secular change and it is strong as compared with the living body sound detection equipment of direct conduction type since it is air conduction type, the high living body sound signal of gain is acquired.

[0005]

[Problem(s) to be Solved by the Invention] However, since the above-mentioned flexible film consisted of comparatively hard ingredients, for example, comparatively hard resin etc., it had given sense of incongruity to the operating personnel-ed at the time of wearing.

[0006] Furthermore, an air space may be made from hair being between the flexible film and skin between the flexible film and skin. On the other hand, an acoustic wave has the property in which the part is reflected in the interface of two media, and a reflection factor becomes high, so that the difference of the specific acoustic resistance R of the medium whose number is two is large. Specific acoustic resistance R is the product of the consistency ρ of a medium, and the acoustic velocity c in the medium here. Therefore, after the air space was formed, in case a living body acoustic wave is transmitted to an air space from the skin, and when being transmitted to the flexible film from an air space, a part will be reflected and the problem that the living body sound detected by living body sound detection equipment will decrease had arisen.

[0007] The place which succeeds in this invention against the background of the above situations, and is made into the purpose is to offer the sheet for wearing of the living body sound detection equipment with which the sense of incongruity at the time of wearing of living body sound detection equipment is mitigated, and a living body sound is suitably detected by the living body sound detection equipment.

[0008]

[Means for Solving the Problem] The place made into the summary of this invention for attaining this purpose The living body sound detection equipment with which is equipped with the microphone which is formed in housing which has opening at the pars basilaris ossis occipitalis, and is stuck by the opening side on a living body's skin, the comparatively hard flexible film which plugs up the opening, and its housing, and changes vibration of a diaphragm into an electrical signal, and it is equipped on the living body's skin, It is the sheet for wearing of the living body sound detection equipment made to intervene between the living body's skins, and is in being made to intervene between said flexible film and said living body's skins, and having the same hardness as the living body's skin, and abbreviation.

[0009]

[Effect of the Invention] thus, if it carries out, the sheet for wearing which has the

same hardness as a living body's skin and abbreviation intervenes between the flexible film and the skin -- making -- ***** -- by things The sense of incongruity at the time of wearing of living body sound detection equipment is mitigated, and the hair of the front face of the skin where the flexible film contacts is further covered without a clearance with the sheet for wearing, namely, since an air space is not made between the flexible film and the skin It is lost that a living body acoustic wave is reflected in the interface of the air space. The consistency of the sheet for wearing in the consistency of the skin rather than the consistency of air Near, With the acoustic velocity nearer to [acoustic velocity / in air] the acoustic velocity in the skin in the sheet for wearing Namely, since the specific acoustic resistance R of the sheet for wearing is closer to the specific acoustic resistance R of the skin than the specific acoustic resistance R of air and there is also comparatively little reflection of the living body sound in the interface of a living body's skin and the sheet for wearing Reduction of a living body sound a living body originates in a hairy thing and is detected by whose living body sound detection equipment is prevented suitably.

[0010]

[Other modes of invention] Here, the sheet for wearing of said living body sound detection equipment has the value as abbreviation at least with the same one side of said living body's skin, and the acoustic velocity in a consistency and a medium suitably. If it does in this way, since the specific acoustic resistance R of the sheet for wearing approaches by the specific acoustic resistance R of a living body's skin and reflection of the living body sound in the interface of a living body's skin and the sheet for wearing will decrease further, reduction of a living body sound a living body originates in a hairy thing and is detected by whose living body sound detection equipment is prevented much more suitably.

[0011] Moreover, said sheet for wearing is suitably stuck on the contact surface with the skin of said flexible film. If it does in this way, the time and effort which makes said sheet for wearing intervene between said flexible film and skins for every measurement will become unnecessary.

[0012] Moreover, said sheet for wearing is made to intervene suitably by all between the field in contact with the skin of said living body of said living body sound detection equipment, and its skin. If it does in this way, since said sheet for wearing will be made to intervene also between the contact surfaces and the skins of the living body sound detection equipment which contacts a living body's skin in addition to the contact surface with the skin of said flexible film, the sense of incongruity at the time of wearing of living body sound detection equipment is mitigated further.

[0013]

[The gestalt of suitable implementation of invention] Hereafter, one example of this invention is explained to a detail based on a drawing.

[0014] Drawing 1 is the perspective view showing the appearance of the heartbeat detection equipment 10 which this invention is applied and detects a heartbeat as a living body sound, drawing 2 is a sectional view explaining the configuration, and the sectional view of the heartbeat detection equipment 10 laid at least in the predetermined heartbeat detecting element on the epidermis 11 of a living body's

center of a thorax is shown. In drawing 1 and drawing 2 heartbeat detection equipment 10 The flat cylinder-like upper housing 12 in which it is constituted with comparatively hard ingredients, such as ABS plastics, and the one direction is carrying out opening. The annular projection 16 to which the bottom housing 14 of the shape of a flat cylinder in which it is similarly constituted with a comparatively hard ingredient, and both directions are carrying out opening was formed in the opening side of the upper housing 12. When the annular projection 20 prepared in opening of the side in which the pars basilaris ossis occipitalis 18 of the bottom housing 14 is not formed fits in, the case 22 on the flat cylinder which carries out opening to an one direction as a whole is accomplished.

[0015] The pars basilaris ossis occipitalis 18 of the bottom housing 14 has the comparatively big circular hole 24 in the center, and the field located in the opposite side serves as a side with the upper housing 12 side of the pars basilaris ossis occipitalis 18 in the field of the side contacted on a living body's epidermis 11.

[0016] In the interior of the case 22 formed with the above top housing 12 and the bottom housing 14, it is constituted by elasticity members, such as silicone rubber, the annular oscillating absorber 28 with an inside diameter a little smaller than the diameter of the circular hole 24 of a pars basilaris ossis occipitalis 18 with an outside diameter equal to the diameter inside a case 22 and is inserted in the pars basilaris ossis occipitalis 18 of the bottom housing 14, and the vibration from the bottom housing 14 is absorbed.

[0017] Furthermore, in the pars basilaris ossis occipitalis 18 of the oscillating absorber 28, it is constituted by the field of the opposite side with comparatively hard resin, and the pan type member 32 which is located in the center of the circular edge 29 where a diameter is a little shorter than the inside diameter of a case 22, and its edge 29, and has the heights 30 with a periphery diameter equal to the inside diameter of the oscillating absorber 28 is inserted in it so that the heights 30 may penetrate the hole of the center of the oscillating absorber 28.

[0018] The taper-like sound-collecting hole 34 where a bottom side serves as a minor diameter is formed in the epidermis 11 side of the heights 30 of the above-mentioned pan type member 32, and opening by the side of the epidermis 11 of the sound-collecting hole 34 which carries out opening to opening of the bottom housing 14 at abbreviation parallel makes the shape of a cap, and is closed by the comparatively hard flexible resin film 36 inserted in and stuck to the side-attachment-wall side of heights 30. This flexible resin film 36 is the same as the flexibility resin film prepared in the press side of the flat press section of a stethoscope, such as about 0.1mm polyvinyl chloride resin, and forms a sound room in the interior of the sound-collecting hole 34.

[0019] Moreover, the hold room 42 for holding a microphone 40 is formed in the opposite side by having the cylinder member 38 in the epidermis 11 of the heights 30 of the above-mentioned pan type member 32. And the circular oscillating absorption sheet 46 which equipped the end face by the side of the sound-collecting hole 34 of the cylinder member 38 with the through tube 44 which has a diameter smaller than the diameter of a microphone 40 in the center is fixed to the abbreviation horizontal to the effective area of the sound-collecting hole 34.

Furthermore, in order to enable vibration perpendicular to the direction of a field of the oscillating absorption sheet 46, in the thickness direction, the circular room 47 thinner than the oscillating absorption sheet 46 is formed in the hold room 42 and the opposite side of the oscillating absorption sheet 46.

[0020] Since the stress of the thickness direction which is extent in which the oscillating absorption sheet 46 is not bent by weight of a microphone 40 is required for the above-mentioned oscillating absorption sheet 46 in the condition that it is constituted by the ingredient of oscillating absorptivity, such as isobutylene isoprene rubber, and vibration does not spread on the oscillating absorption sheet 46, thickness is the thing of 1.0 – 2.0 mm suitably. If vibration spreads on this oscillating absorption sheet 46, the oscillating absorption sheet 46 will absorb vibration which vibrated at right angles to the direction of a field, and has been spread, and will function as a low pass filter from which especially vibration of 50Hz or less is removed suitably. And since the frequency of a heartbeat is 50Hz or more (for example, II sound is 100–150Hz), a heartbeat is detectable where [suitable] the noise by the side of low frequency is removed.

[0021] The microphone case 48 which a microphone 40 is fixed with adhesives etc. so that the through tube 44 of the oscillating absorption sheet 46 may be closed at the hold room 42, and carries out opening to the through tube 44 side, The diaphragm 50 which is held so that it may become parallel with the oscillating absorption sheet 46 in the microphone case 48 at the through tube 44 side, and functions as an electrode, The fixed electrode 52 which separates the diaphragm 50 and few about 0.01–0.05mm clearances, and counters, The connection terminal 56 of a pair connected with lead wire 54 in the opposite side in the through tube 44 of the microphone case 48, It is the electrostatic-capacity mold microphone equipped with the insulating member 58 which insulates between the connection terminals 56 of the pair, i.e., a condenser type microphone, and by vibrating a diaphragm 50, the heartbeat from the skin 11 is detected and the cardiac correspondence number showing the heartbeat is outputted.

[0022] The field of the opposite side is in contact with weight 60 the side which is in contact with the oscillating absorber 28 of the above-mentioned pan type member 32. The weight 60 consists of ingredients with comparatively heavy specific gravity, such as lead, copper, and iron. It is the flat cylindrical shape with a diameter equal to the diameter of the edge 29 of the pan type member 32 suitably made into about [80–150g] weight. Between a center section and the center section of the inside flat surface 62 of the upper housing of the field which faces the field 62 of the opposite side, i.e., the inside flat surface of the upper housing 12, the side which is in contact with the pan type member 32 While the oscillating absorber 64 which consisted of the same quality of the materials as said oscillating absorber 28 is fixed and absorbing the vibration from the upper housing 12, a location gap of weight 60 is controlled by pinching weight 60 by floating by the oscillating absorber 28 and the oscillating absorber 64. Since this weight 60 consists of ingredients of above comparatively heavy specific gravity, and it has the above-mentioned weight, and the noise from the outside of a living body insulates with weight 60 and heartbeat detection equipment 10 presses a living body's skin 11 by suitable fixed thrust, a cardiac correspondence number

with the stable repeatability is detectable. Furthermore, since the resonance frequency of the heartbeat detection equipment 10 whole serves as a low frequency region from the frequency of a heartbeat and the energy of the heartbeat from in the living body is not consumed as energy which vibrates living body sound detection equipment 10, a heartbeat is efficiently detected by the microphone 40.

[0023] Since the diameter of the above-mentioned weight 60 and the diameter of the edge 29 of the pan type member 32 are made a little shorter than the inside diameter of a case 22 as mentioned above, and the oscillating absorber 64 is further fixed between weight 60 and the upper housing 12, the sealed air chamber 66 is formed between the case 22, and weight 60 and the pan type member 32. Since it is absorbed without reflecting the ambient noise from the outside of a living body in the interface of this sealed air chamber 66 and a case 22, or resonating within an air chamber 66, it is controlled that ambient noise is detected by the microphone 40 which it had inside the air chamber 66.

[0024] Moreover, between the taper-like sound-collecting hole 34 and the hold room 42 An end is open for free passage with the taper-like sound-collecting hole 34, and the other end is made open for free passage by the hold room 42 and the free passage way 68 to open for free passage. Further to an insulating member 58 The atmospheric-pressure tone spear reaming 70 which penetrates the insulating member 58 is formed, and since it is adjusted so that the atmospheric pressure of both sides of a diaphragm 50 may become the same, only the fluctuation component (AC component) of the pressure in the taper-like sound-collecting hole 34 is detected by the microphone 40.

[0025] And the lead wire 54 connected to the connection terminal of a microphone 40 passes along the hole 72 established in some of pan type members 32 and weights 60, and is connected to the connection terminal 76 at the tip of the code 75 which prepared in the side face of a case 22 and was inserted in the **** through hole 74.

[0026] Moreover, the elasticity sheet 77 is stuck on the field of the side contacted on the skin 11 of said flexible resin film 36. This elasticity sheet 77 is JIS, for example while constituting the sheet for wearing of this example and having the thickness of 0.5 – 2.0 mm extent. It is the elastic body or gel viscosity object which is equipped with the same hardness as the skin of the 1 degree – about 15 degrees body, and abbreviation with A mold spring-loaded type hardness tester, and has the still more nearly same consistency as the skin 11. Since the hair 78 on the skin 11 can be covered, namely, is not made by the air space by existence of this elasticity sheet 77 between the flexible resin film 36 and the skin 11 while the sense of incongruity when being equipped with heartbeat detection equipment 10 on the skin 11 is mitigable, it is lost that the heartbeat from in the living body is reflected by that air space. Moreover, since it can conclude that the specific acoustic resistance R of the elasticity sheet 77 and its specific acoustic resistance R of the skin 11 correspond comparatively since the elasticity sheet 77 is equipped with the consistency of the skin 11, and the same consistency as abbreviation Since there is also little reflection in the interface of the skin 11 and the elasticity sheet 77, and the elasticity sheet 77 is comparatively thin as

mentioned above and there is also little cardiac acoustical absorption in the inside of the elasticity sheet 77, reduction of the heartbeat spread in heartbeat detection equipment 10 from the skin 11 is controlled.

[0027] Furthermore, the same quality of the materials as said elasticity sheet 77 are consisted of by the field by the side of the skin 11 of the pars basilaris ossis occipitalis 18 of said bottom housing 14, and the annular elasticity sheet 80 of the field by the side of the skin of a pars basilaris ossis occipitalis 18 and abbreviation identitas is stuck on it. This annular elasticity sheet 80 intercepts much more suitably the ambient noise which spreads the inside of a body tissue and reaches heartbeat detection equipment 10 rather than the case where the direct skin 11 is equipped with the bottom housing 18 while mitigating the sense of incongruity when being equipped with heartbeat detection equipment 10 on the skin 11. Furthermore, since the elasticity sheet 80 sticks to the skin 11 even if some irregularity is in the skin 11 of the part where it was equipped with heartbeat detection equipment 10, it is prevented that the stowed position of heartbeat detection equipment 10 shifts.

[0028] Drawing 3 is drawing explaining the heartbeat detected by heartbeat detection equipment 82 when an air space is made decreasing in the conventional heartbeat detection equipment 82 with which it is not equipped with said elasticity sheet 77, and the condition that at least the predetermined heartbeat detecting element on a living body's skin 11 was equipped with heartbeat detection equipment 82 is shown.

[0029] In drawing 3, the air space 86 is formed of the hair 78 on the skin 11 between the contact surface 84 with the skin of heartbeat detection equipment 82, and the skin 11. In this condition, since a part is reflected as a reflected wave 90 in case the cardiac acoustic wave 88 progresses to an air space 86 from the skin 11, and in case it progresses to heartbeat detection equipment 82 from an air space 86, the cardiac acoustic wave 88 detected by heartbeat detection equipment 82 will decrease.

[0030] as mentioned above, according to this example, the elasticity sheet 77 which has the same hardness as the skin 11 and abbreviation intervenes between the flexible resin film 36 and the skin 11 -- making -- ***** -- by things The sense of incongruity at the time of wearing of heartbeat detection equipment 10 is mitigated, and the hair 78 of the front face of the skin 11 where the flexible resin film 36 contacts is further covered without a clearance with the elasticity sheet 77. Namely, since an air space is not made between the flexible resin film 36 and the skin 11 It is lost that the cardiac acoustic wave 88 is reflected in the interface of the air space. The consistency of the elasticity sheet 77 in the consistency of the skin 11 rather than the consistency of air Near, With the acoustic velocity nearer to [acoustic velocity / in air] the acoustic velocity in the skin 11 in the elasticity sheet 77 Namely, since the specific acoustic resistance R of the sheet for wearing is closer to the specific acoustic resistance R of the skin 11 than the specific acoustic resistance R of air and there is also comparatively little reflection of the heartbeat in the interface of the skin 11 and the elasticity sheet 77 Reduction of a heartbeat a living body originates in a hairy thing and is detected by whose heartbeat detection equipment 10 is prevented suitably.

[0031] Moreover, according to this example, since the elasticity sheet 77 has the same consistency as the skin 11 and abbreviation, the specific acoustic resistance R of the elasticity sheet 77 approaches by the specific acoustic resistance R of the skin 11 and reflection of the heartbeat in the interface of the skin 11 and the elasticity sheet 77 decreases further, reduction of a heartbeat a living body originates in a hairy thing and is detected by whose heartbeat detection equipment 10 is prevented much more suitably.

[0032] Moreover, according to this example, since the elasticity sheet 77 is stuck on the contact surface with the skin 11 of the flexible resin film 36, the time and effort which makes the elasticity sheet 77 intervene between the flexible resin film 36 and the skin 11 for every measurement becomes unnecessary.

[0033] Moreover, since the annular elasticity sheet 80 is made to intervene between the pars basilaris ossis occipitalis 18 of the bottom housing 14, and the skin 11 in addition to the elasticity sheet 77 stuck on the contact surface with the skin 11 of the flexible resin film 36 according to this example, the sense of incongruity at the time of wearing of heartbeat detection equipment 10 is mitigated further.

[0034] As mentioned above, although one example of this invention was explained based on the drawing, this invention is applied also in other modes.

[0035] For example, although the elasticity sheets 77 and 80 were beforehand stuck on the pars basilaris ossis occipitalis 18 of the flexible resin film 36 or the bottom housing 14 as some heartbeat detection equipments 10, the elasticity sheets 77 and 80 and the sheet for wearing of the same quality of the material may be made to intervene between heartbeat detection equipment 10 and the skin 11 independently [heartbeat detection equipment 10] in the above-mentioned example.

[0036] Moreover, although the electrostatic-capacity mold microphone was used for the microphone 40 in the above-mentioned example, you may be a piezo-electric mold microphone and a moving-coil-type microphone.

[0037] In addition, in the range in which this invention does not deviate from the main point, modification may be added variously.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the perspective view of the heartbeat detection equipment 10 which is one example of this invention.

[Drawing 2] It is the sectional view of the heartbeat detection equipment 10 of the example of drawing 1 .

[Drawing 3] It is drawing explaining the condition that a part of cardiac acoustic wave from in the living body is reflected by the air space.

[Explanation of agreement]

10: Heartbeat detection equipment

11: Skin

12: Upper housing

14: Bottom housing

36: Flexible resin film

40: Microphone

76 80: Elasticity sheet (sheet for wearing)

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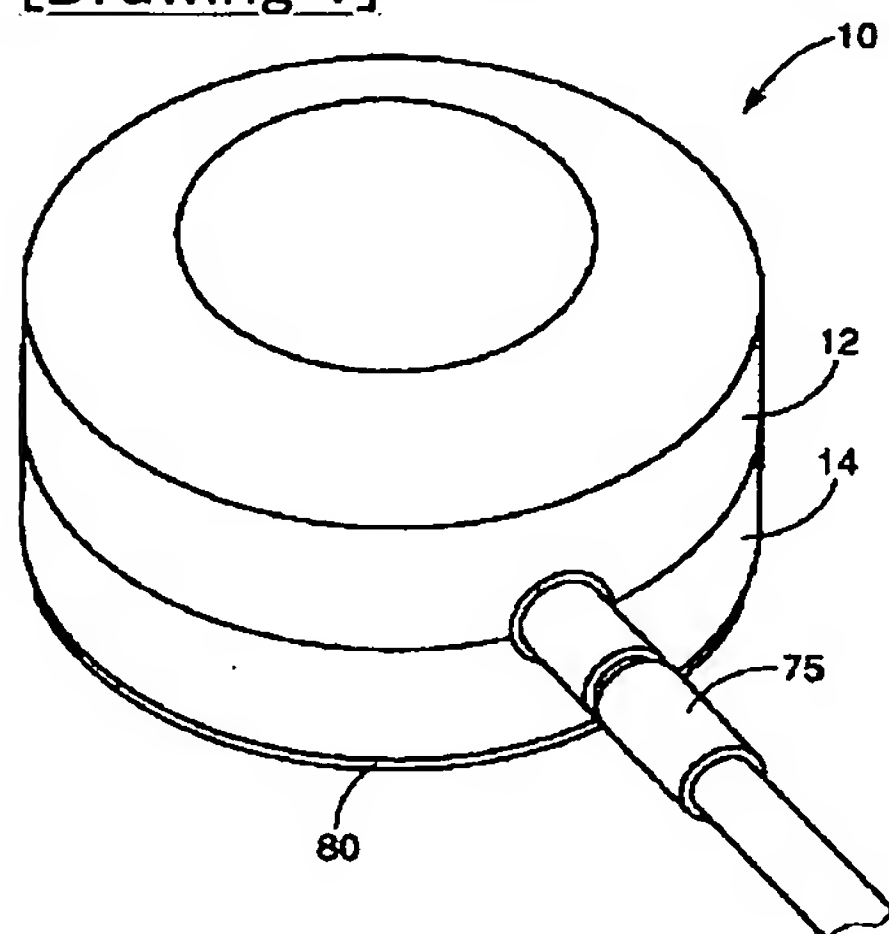
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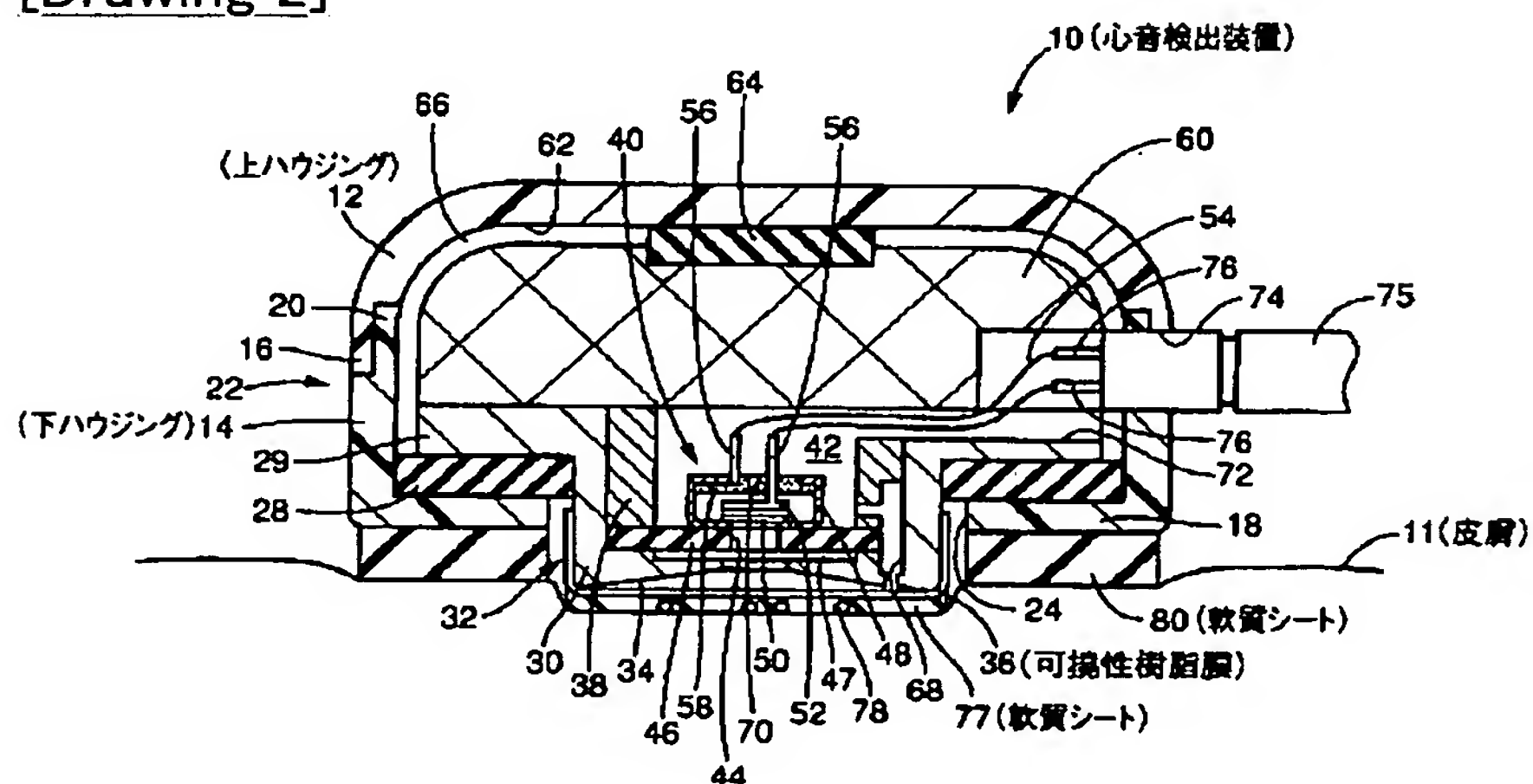
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DRAWINGS

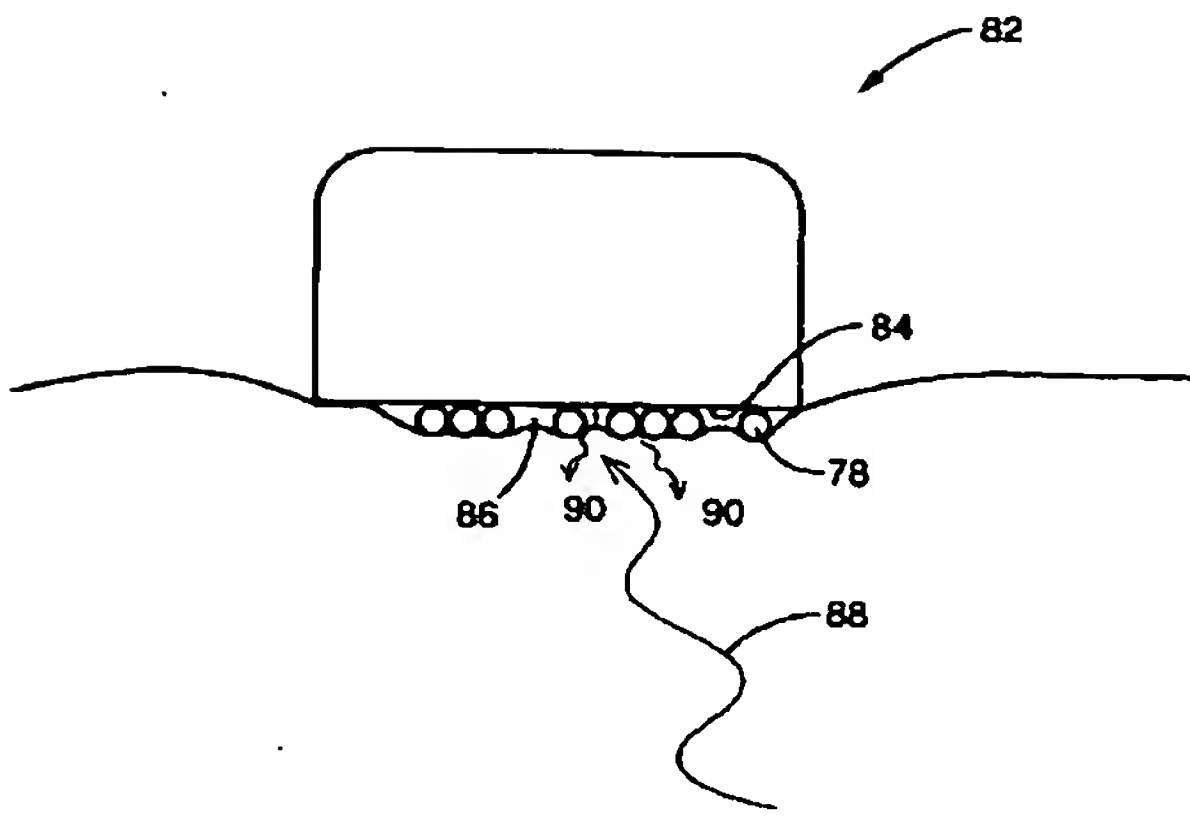
[Drawing 1]



[Drawing 2]



[Drawing 3]



[Translation done.]

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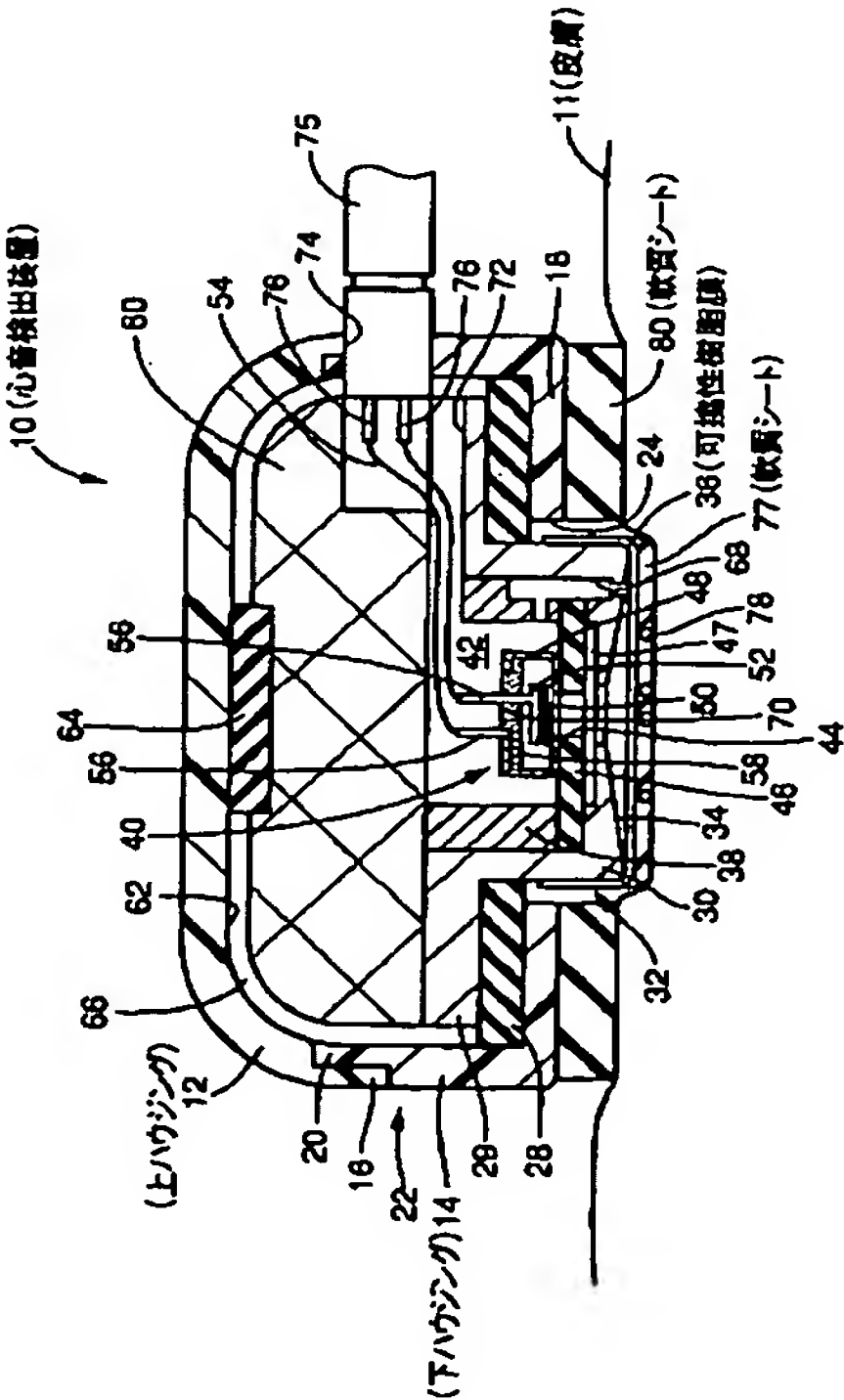
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(54) 【発明の名称】 生体音検出装置の装着用シート

(57) 【要約】 (修正有)

【課題】 生体音検出装置の装着時の違和感を軽減し、且つその生体音検出装置に生体音が好適に検出される生体音検出装置の装着用シートを提供する。

【解決手段】 皮膚 1 1 と略同様の粘度を有する軟質シート 7 6 が、可撓性樹脂膜 3 6 と皮膚 1 1 との間に介在させられることにより、心音検出装置の装着時の違和感が軽減され、さらに、可撓性樹脂膜 3 6 が接触する皮膚 1 1 の表面の体毛 7 8 が軟質シート 7 6 により隙間なく覆われる、すなわち、可撓性樹脂膜 3 6 と皮膚 1 1 との間に空気層ができないので、その空気層の境界面で心音波が反射されることがなくなり、空気固有音響抵抗 R よりも装着用シートの固有音響抵抗 R の方が皮膚 1 1 の固有音響抵抗 R に近いことから、皮膚 1 1 と軟質シート 7 6 との境界面での心音の反射も比較的少ないので、生体が毛深いことに起因して心音検出装置に検出される心音の減少が好適に防止される。



【特許請求の範囲】

【請求項 1】 底部に開口を有して該開口側が生体の皮膚上に密着させられるハウジングと該開口部を塞ぐ比較的硬質の可撓性膜と該ハウジング内に設けられて振動板の振動を電気信号に変換するマイクロホンとを備えて該生体の皮膚上に装着される生体音検出装置と、該生体の皮膚との間に介在させられる生体音検出装置の装着用シートであって、

前記可撓性膜と前記生体の皮膚との間に介在させられ、且つ該生体の皮膚と略同様の硬さを有することを特徴とする生体音検出装置の装着用シート。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】 本発明は、生体の心臓や呼吸器系等の疾患を診断するために、生体内で生じる生体音を検出して、その生体音を表す生体音信号を出力する生体音検出装置に関し、特にその生体音検出装置に生体音が一層好適な状態で検出されるための技術に関するものである。

【0002】

【従来の技術】 たとえば、心疾患や呼吸器系等の生体の疾患を診断するために、生体の所定部位の皮膚上に装着され、その生体内で生じる心音、呼吸音、胸膜音、動脈音、腸音等の生体音を検出してその生体音を表す生体音信号を出力する生体音検出装置を用いた診断が行われている。たとえば、胸部の皮膚上に装着される心音検出装置により心音を検出して心音図を測定し、その心音図から心疾患の診断が行なわれる。患者に心疾患がある場合は、その患者を測定して得られた心音図には、正常な心音に加えて、心疾患に起因して発生する心雑音が含まれるため、心疾患を診断することができるのである。

【0003】 上記生体音検出装置は、生体音の音波すなわち生体音波が皮膚に伝達されることによる皮膚の振動を検出するものであり、皮膚の振動が生体音検出装置の皮膚側の開口からその生体音検出装置内の空気に伝達され、その空気の振動に基づいて生体音を検出する空気伝導形や、生体の皮膚に接触させられた生体音検出装置の一部材に皮膚の振動が伝達され、その一部材の振動に基づいて生体音を検出する直接伝導形がある。

【0004】 上記空気伝導形の生体音検出装置には、ゲインの高い生体音信号を得るために、生体の皮膚と接触させられるハウジングの開口を比較的硬質の可撓性膜で塞いだ生体音検出装置が提案されている。たとえば、本出願人が先に出願した特願平 9-120531 号記載の心音検出装置がそれである。この心音検出装置によれば、空気伝導形であるので、直接伝導形の生体音検出装置と比較して経年変化が少なく堅牢であるという利点があることに加えて、開口部が塞がれることにより音響室が形成されるので、ゲインの高い生体音信号が得られるのである。

【0005】

【発明が解決すべき課題】 しかしながら、上記可撓性膜は比較的硬質の材料、たとえば比較的硬質の樹脂等で構成されるため、装着時に被測定者に違和感を与えていた。

【0006】 さらに、その可撓性膜と皮膚との間に体毛があることより、その可撓性膜と皮膚との間に空気層ができってしまう場合がある。一方、音波は 2 つの媒質の境界面でその一部が反射される性質があり、2 つの媒質の固有音響抵抗 R の差が大きいほど反射率は高くなる。ここで固有音響抵抗 R とは媒質の密度 ρ とその媒質中の音速 c との積である。従って、空気層が形成されてしまうと、生体音波が皮膚から空気層へ伝達される際および空気層から可撓性膜へと伝達される際に、一部が反射されてしまい、生体音検出装置に検出される生体音が減少してしまうという問題が生じていた。

【0007】 本発明は以上のような事情を背景として為されたものであり、その目的とするところは、生体音検出装置の装着時の違和感を軽減し、且つその生体音検出装置に生体音が好適に検出される生体音検出装置の装着用シートを提供することにある。

【0008】

【課題を解決するための手段】 かかる目的を達成するための本発明の要旨とするところは、底部に開口を有してその開口側が生体の皮膚上に密着させられるハウジングとその開口部を塞ぐ比較的硬質の可撓性膜とそのハウジング内に設けられて振動板の振動を電気信号に変換するマイクロホンとを備えてその生体の皮膚上に装着される生体音検出装置と、その生体の皮膚との間に介在させられる生体音検出装置の装着用シートであって、前記可撓性膜と前記生体の皮膚との間に介在させられ、且つその生体の皮膚と略同様の硬さを有することにある。

【0009】

【発明の効果】 このようにすれば、生体の皮膚と略同様の硬さを有する装着用シートが、可撓性膜と皮膚との間に介在させられることにより、生体音検出装置の装着時の違和感が軽減され、さらに、可撓性膜が接触する皮膚の表面の毛が装着用シートにより隙間なく覆われる、すなわち、可撓性膜と皮膚との間に空気層ができないので、その空気層の境界面で生体音波が反射されることがなくなり、且つ空気の密度よりも装着用シートの密度の方が皮膚の密度に近く、空気中の音速よりも装着用シート中の音速の方が皮膚中の音速に近い、すなわち、空気の固有音響抵抗 R よりも装着用シートの固有音響抵抗 R の方が皮膚の固有音響抵抗 R に近いことから、生体の皮膚と装着用シートとの境界面での生体音の反射も比較的少ないので、生体が毛深いことに起因して生体音検出装置に検出される生体音の減少が好適に防止される。

【0010】

【発明の他の態様】 ここで、好適には、前記生体音検出

装置の装着用シートは、前記生体の皮膚と、密度および媒質中の音速の少なくとも一方が略同様の値を有するものである。このようにすれば、装着用シートの固有音響抵抗Rが生体の皮膚の固有音響抵抗Rにより近づくことから、生体の皮膚と装着用シートとの境界面での生体音の反射が一層減少するので、生体が毛深いことに起因して生体音検出装置に検出される生体音の減少が一層好適に防止される。

【0011】また、好適には、前記装着用シートは、前記可撓性膜の皮膚との接触面に貼りつけられているものである。このようにすれば、測定毎に前記装着用シートを前記可撓性膜と皮膚との間に介在させる手間が不要になる。

【0012】また、好適には、前記装着用シートは、前記生体音検出装置の前記生体の皮膚と接触する面と、その皮膚との間の全部に介在させられるものである。このようにすれば、前記可撓性膜の皮膚との接触面以外において、生体の皮膚と接触する生体音検出装置の接触面とその皮膚との間にも前記装着用シートが介在させられるので、生体音検出装置の装着時の違和感が一層軽減される。

【0013】

【発明の好適な実施の形態】以下、本発明の一実施例を図面に基づいて詳細に説明する。

【0014】図1は、本発明が適用され、生体音として心音を検出する心音検出装置10の外観を示す斜視図であり、図2はその構成を説明する断面図であって、生体の胸部中央の表皮11上の所定の心音検出部位に載置された心音検出装置10の断面図が示されている。図1および図2において、心音検出装置10は、ABS樹脂等の比較的硬質な材料により構成され、一方向が開口している扁平な円柱状の上ハウジング12と、同様に比較的硬質な材料により構成され、両方向が開口している扁平な円柱状の下ハウジング14とが、上ハウジング12の開口側に設けられた環状突起16と、下ハウジング14の底部18が設けられていない側の開口に設けられた環状突起20とが嵌合することにより全体として一方向に開口する扁平な円柱上の筐体22を成している。

【0015】下ハウジング14の底部18は中央に比較的大きな円形穴24を有し、その底部18の上ハウジング12側がある側とは反対側に位置する面が生体の表皮11に接触させられる側の面になるのである。

【0016】上記上ハウジング12と下ハウジング14とで形成された筐体22の内部において、下ハウジング14の底部18には、シリコンゴム等の軟質部材により構成され、外側直径が筐体22の内側の直径に等しく且つ内側直径が底部18の円形穴24の直径よりもやや小さい環状の振動吸収体28が嵌め付けられて、下ハウジング14からの振動を吸収する。

【0017】さらに、その振動吸収体28の底部18と

は反対側の面には、比較的硬質の樹脂により構成され、直径が筐体22の内側直径よりもやや短い円形の縁部29と、その縁部29の中央に位置し外周直径が振動吸収体28の内側直径と等しい凸部30とを有する皿型部材32が、その凸部30が振動吸収体28の中央の穴を貫通するように嵌め付けられている。

【0018】上記皿型部材32の凸部30の表皮11側には、底側ほど小径となるテーパ状の集音穴34が形成されており、下ハウジング14の開口と略平行に開口する集音穴34の表皮11側の開口部は、キャップ状をなして凸部30の側壁面に嵌め着けられた比較的硬質の可撓性樹脂膜36により塞がれている。この可撓性樹脂膜36は、たとえば0.1mm程度のポリ塩化ビニル樹脂等、聴診器の扁平押圧部の押圧面に設けられる可撓性樹脂膜と同様のものであり、集音穴34の内部において音響室を形成する。

【0019】また、上記皿型部材32の凸部30の表皮11とは反対側には、円筒部材38が備えられることにより、マイクロホン40を收容するための收容室42が形成されている。そして、円筒部材38の集音穴34側の端面には、中央にマイクロホン40の直径よりも小さい直径を有する貫通孔44を備えた円形の振動吸収シート46が、集音穴34の開口面に対して略水平に固設されている。さらに、その振動吸収シート46の收容室42と反対側には、その振動吸収シート46の面方向に垂直な振動を可能とするために、厚み方向において振動吸収シート46よりも薄い円形室47が形成されている。

【0020】上記振動吸収シート46はブチルゴム等の振動吸収性の材料により構成され、振動吸収シート46に振動が伝播されていない状態ではマイクロホン40の重さで振動吸収シート46が撓まない程度の厚み方向の応力が必要であるため、好適には厚さが1.0～2.0mmのものである。この振動吸収シート46に振動が伝播すると、振動吸収シート46は面方向に垂直に振動して伝播してきた振動を吸収し、特に50Hz以下の振動を好適に除去するローパスフィルタとして機能する。そして、心音の周波数は50Hz以上（たとえばII音は100～150Hz）であるので、低周波数側のノイズを取り除いた好適な状態で心音が検出できる。

【0021】マイクロホン40は、收容室42において振動吸収シート46の貫通孔44を塞ぐように接着剤等により固設され、その貫通孔44側に開口するマイクロホンケース48と、そのマイクロホンケース48内においてその貫通孔44側に振動吸収シート46と平行となるように收容されて電極として機能する振動板50と、その振動板50と0.01～0.05mm程度の僅かな隙間を隔てて対向する固定電極52と、そのマイクロホンケース48の貫通孔44とは反対側において導線54と接続される一対の接続端子56と、その一対の接続端子56間を絶縁する絶縁部材58とを備えた静電容量型マイクロホ

ン、すなわちコンデンサ型マイクロホンであり、振動板 50 が振動させられることにより皮膚 11 からの心音を検出し、その心音を表す心音信号を出力する。

【0022】上記皿型部材 32 の振動吸収体 28 と接している側とは反対側の面は重り 60 と接している。その重り 60 は、鉛、銅、鉄等の比較的比重の重い材料で構成され、好適には 80 ～ 150 g 程度の重さとされた、直径が皿型部材 32 の縁部 29 の直径と等しい偏平な円柱形であり、皿型部材 32 と接している側とは反対側の面、すなわち上ハウジング 12 の内側平面 62 と向かい合う面の中央部と、その上ハウジングの内側平面 62 の中央部との間には、前記振動吸収体 28 と同じ材質で構成された振動吸収体 64 が固設され、上ハウジング 12 からの振動を吸収するとともに、振動吸収体 28 と振動吸収体 64 とによって重り 60 が浮動状態で挟持されることにより、重り 60 の位置ずれが抑制される。この重り 60 が上記のように比較的重い比重の材料で構成され且つ上記の重量を有していることから、生体外からの雑音が重り 60 により遮音され、且つ心音検出装置 10 が好適な一定の押圧力で生体の皮膚 11 を押圧するので、安定した再現性のある心音信号が検出できる。さらに、心音検出装置 10 全体の共振周波数が心音の周波数よりも低周波数域となることから、生体内からの心音のエネルギーが生体音検出装置 10 を振動させるエネルギーとして消費されることがないので、心音がマイクロホン 40 に効率よく検出される。

【0023】上記重り 60 の直径および皿型部材 32 の縁部 29 の直径は、前述したように筐体 22 の内側直径よりもやや短くされ、さらに重り 60 と上ハウジング 12 との間には振動吸収体 64 が固設されているので、その筐体 22 と、重り 60 および皿型部材 32 との間には密閉された空気室 66 が形成される。生体外からの環境雑音は、この密閉された空気室 66 と筐体 22 の境界面で反射され、或いは空気室 66 内で共鳴することなく吸収されるので、環境雑音が空気室 66 の内側に備えられたマイクロホン 40 に検出されることが抑制される。

【0024】また、テーパ状の集音穴 34 と収容室 42 との間は、一端がテーパ状集音穴 34 と連通し他端が収容室 42 と連通する連通路 68 により連通させられ、さらに、絶縁部材 58 には、その絶縁部材 58 を貫通する気圧調整孔 70 が設けられ、振動板 50 の両面の気圧が同一となるように調整されているので、テーパ状の集音穴 34 内の圧力の変動成分（AC 成分）のみがマイクロホン 40 に検出される。

【0025】そして、マイクロホン 40 の接続端子に接続された導線 54 は、皿型部材 32 および重り 60 の一部に設けられた穴 72 を通って、筐体 22 の側面に設けられた貫通穴 74 に差し込まれたコード 75 の先端の接続端子 76 に接続されている。

【0026】また、前記可撓性樹脂膜 36 の皮膚 11 と

接触させられる側の面には軟質シート 77 が貼りつけられている。この軟質シート 77 は、本実施例の装着用シートを構成するものであって、たとえば 0.5 ～ 2.0 mm 程度の厚みを有しているとともに、たとえば JIS A 型スプリング式硬さ試験機で 1° ～ 15° 程度の人体の皮膚と略同様の硬さを備え、さらに皮膚 11 と同様の密度を有する弾性体或いはゲル状粘性体である。この軟質シート 77 の存在により、心音検出装置 10 が皮膚 11 上に装着されたときの違和感を軽減できるとともに、皮膚 11 上の体毛 78 を覆うことができる、すなわち、可撓性樹脂膜 36 と皮膚 11 との間に空気層ができないので、生体内からの心音とその空気層で反射されることがなくなる。また、軟質シート 77 は皮膚 11 の密度と略同様の密度を備えていることから、軟質シート 77 の固有音響抵抗 R と皮膚 11 の固有音響抵抗 R とは比較的一致しているとみることができ、皮膚 11 と軟質シート 77 との境界面での反射も少なく、且つ軟質シート 77 は上記のように比較的薄いことから、軟質シート 77 中での心音の吸収も少ないので、皮膚 11 から心音検出装置 10 内に伝播する心音の減少が抑制される。

【0027】さらに、前記下ハウジング 14 の底部 18 の皮膚 11 側の面には、前記軟質シート 77 と同様の材質で構成され、底部 18 の皮膚側の面と略同一の環状の軟質シート 80 が貼りつけられている。この環状の軟質シート 80 は、心音検出装置 10 が皮膚 11 上に装着されたときの違和感を軽減するとともに、下ハウジング 18 が直接皮膚 11 に装着された場合よりも、生体組織中を伝播して心音検出装置 10 に到達する環境雑音を一層好適に遮断する。さらに、心音検出装置 10 の装着された部位の皮膚 11 に多少の凹凸があっても、軟質シート 80 がその皮膚 11 に密着するので、心音検出装置 10 の装着位置がずれることが防止される。

【0028】図 3 は、前記軟質シート 77 が装着されていない従来の心音検出装置 82 において、空気層ができてしまうことによって、心音検出装置 82 に検出される心音が減少することを説明する図であり、心音検出装置 82 が生体の皮膚 11 上の所定の心音検出部位に装着された状態が示されている。

【0029】図 3 において、皮膚 11 上の体毛 78 により、心音検出装置 82 の皮膚との接触面 84 と皮膚 11 との間に空気層 86 が形成されている。この状態において、心音波 88 が皮膚 11 から空気層 86 に進む際、および空気層 86 から心音検出装置 82 へ進む際に一部が反射波 90 として反射されるので、心音検出装置 82 に検出される心音波 88 が減少してしまう。

【0030】上述のように、本実施例によれば、皮膚 11 と略同様の硬さを有する軟質シート 77 が、可撓性樹脂膜 36 と皮膚 11 との間に介在させられることにより、心音検出装置 10 の装着時の違和感が軽減され、さらに、可撓性樹脂膜 36 が接触する皮膚 11 の表面の体

毛 78 が軟質シート 77 により隙間なく覆われる、すなわち、可撓性樹脂膜 36 と皮膚 11 との間に空気層ができないので、その空気層の境界面で心音波 88 が反射されることがなくなり、且つ空気の密度よりも軟質シート 77 の密度の方が皮膚 11 の密度に近く、空気中の音速よりも軟質シート 77 中の音速の方が皮膚 11 中の音速に近い、すなわち、空気の固有音響抵抗 R よりも装着用シートの固有音響抵抗 R の方が皮膚 11 の固有音響抵抗 R に近いことから、皮膚 11 と軟質シート 77 との境界面での心音の反射も比較的少ないので、生体が毛深いことに起因して心音検出装置 10 に検出される心音の減少が好適に防止される。

【0031】また、本実施例によれば、軟質シート 77 は皮膚 11 と略同様の密度を有するものであるので、軟質シート 77 の固有音響抵抗 R が皮膚 11 の固有音響抵抗 R により近づくことから、皮膚 11 と軟質シート 77 との境界面での心音の反射が一層減少するので、生体が毛深いことに起因して心音検出装置 10 に検出される心音の減少が一層好適に防止される。

【0032】また、本実施例によれば、軟質シート 77 は、可撓性樹脂膜 36 の皮膚 11 との接触面に貼りつけられているので、測定毎に軟質シート 77 を可撓性樹脂膜 36 と皮膚 11 との間に介在させる手間が不要になる。

【0033】また、本実施例によれば、可撓性樹脂膜 36 の皮膚 11 との接触面に貼りつけられる軟質シート 77 に加えて、環状の軟質シート 80 が下ハウジング 14 の底部 18 と皮膚 11 との間に介在させられているので、心音検出装置 10 の装着時の違和感が一層軽減される。

【0034】以上、本発明の一実施例を図面に基づいて説明したが、本発明はその他の態様においても適用される。

【0035】たとえば、前述の実施例では、軟質シート 77、80 は、心音検出装置 10 の一部として予め可撓性樹脂膜 36 または下ハウジング 14 の底部 18 に貼りつけられていたが、心音検出装置 10 とは別に軟質シート 77、80 と同様の材質の装着用シートが心音検出装置 10 と皮膚 11 との間に介在させられてもよい。

【0036】また、前述の実施例では、マイクロホン 40 には、静電容量型マイクロホンが用いられていたが、圧電型マイクロホンやムービングコイル型マイクロホンであってもよい。

【0037】その他、本発明はその主旨を逸脱しない範囲において種々変更が加えられ得るものである。

【図面の簡単な説明】

【図 1】本発明の一実施例である心音検出装置 10 の斜視図である。

【図 2】図 1 の実施例の心音検出装置 10 の断面図である。

【図 3】空気層により生体内からの心音波の一部が反射される状態を説明する図である。

【符号の説明】

10：心音検出装置

11：皮膚

12：上ハウジング

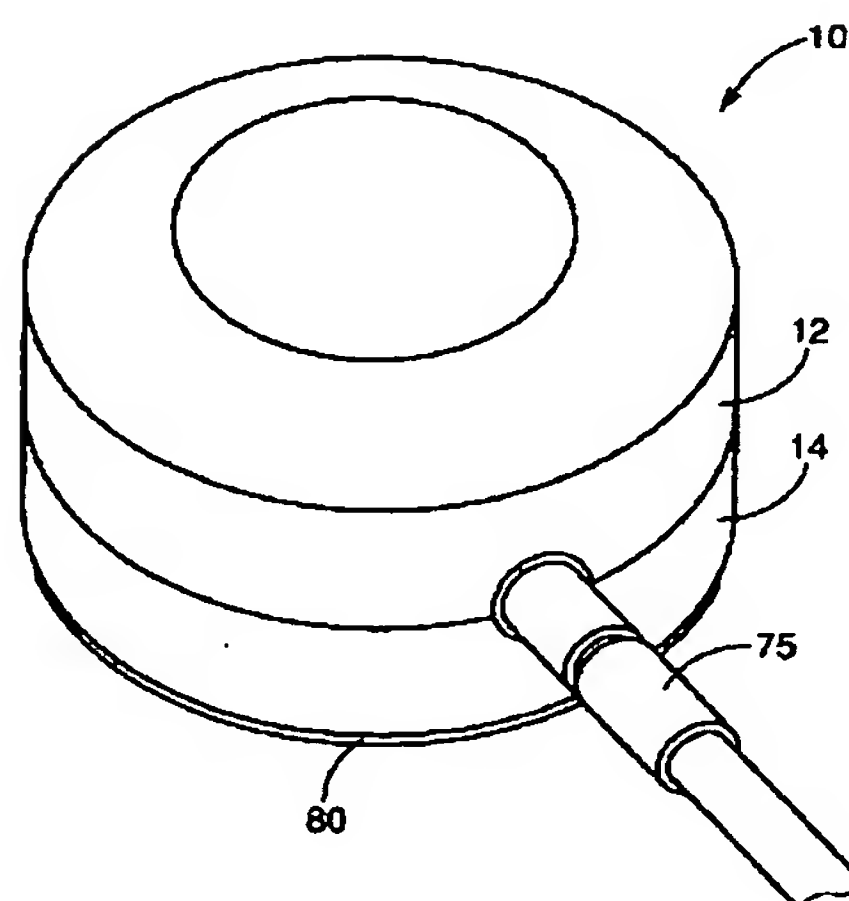
14：下ハウジング

36：可撓性樹脂膜

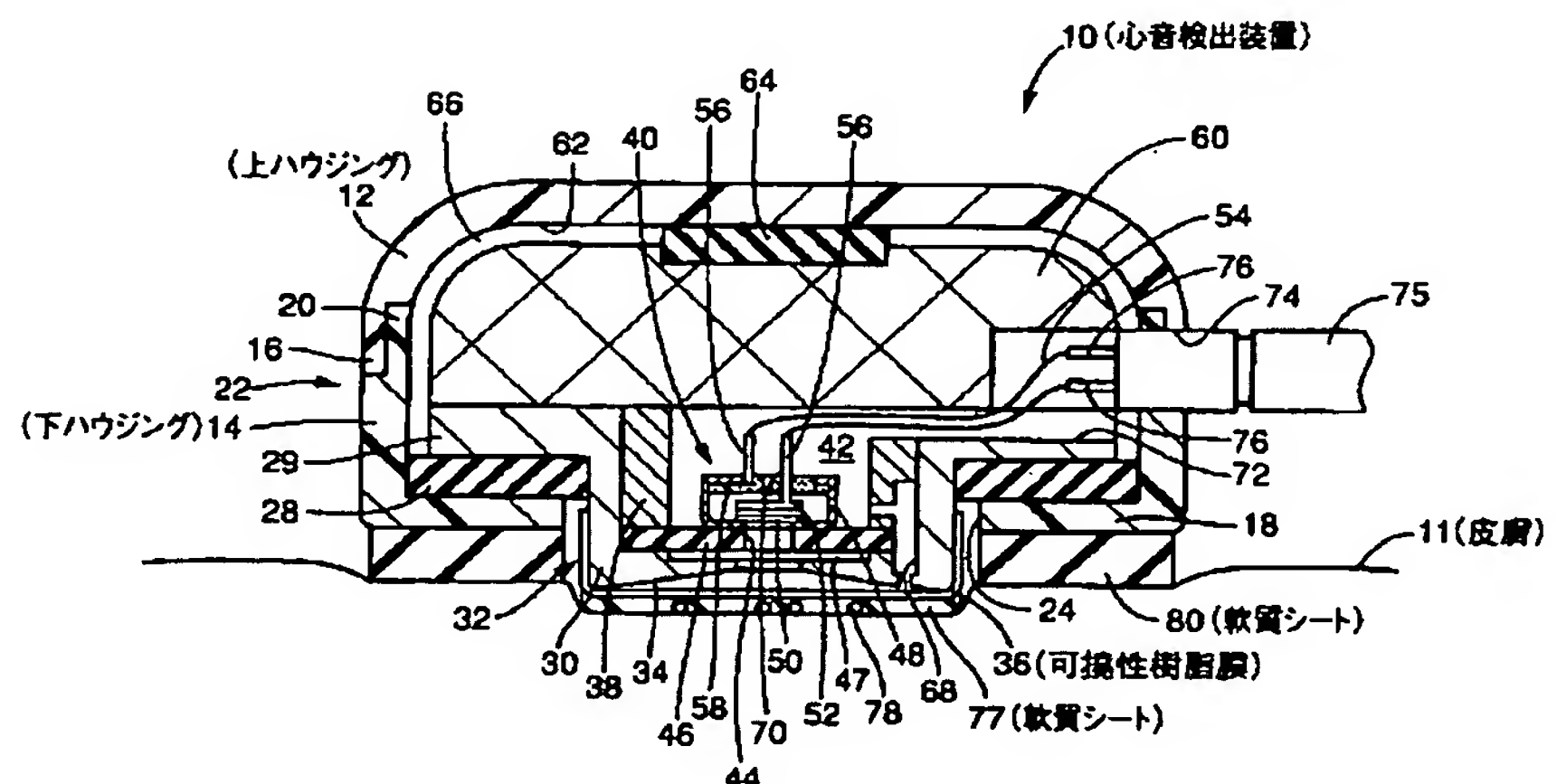
40：マイクロホン

76、80：軟質シート（装着用シート）

【図 1】



【図 2】



【図 3】

